

AMENDMENTS TO THE SPECIFICATION

The paragraphs amended herein incorporate the amendments to the specification presented in the Preliminary Amendment filed on June 28, 2004.

Please replace the paragraph beginning on line 15 on page 2 with the following rewritten paragraph.

If this LD driving circuit is driven by a negative voltage as shown in Fig. 18, a first transition of an electric signal pulse corresponding to a first transition of an optical signal pulse is a segment of the eye pattern directed downward whereas a second transition thereof is a segment of the eye pattern directed upward. As shown in Fig. 19, a fall time T_f is longer than a rise time T_r by about 40 ~~percents~~ percent.

Please replace the paragraph beginning at line 19 on page 3 with the following rewritten paragraph.

Nevertheless, if a modulated signal at 10 Gb/s or more is to be transmitted, the optical output waveform of the LD module is conspicuously deteriorated as shown in Fig. 20. As can be seen from the waveform shown in Fig. 20, there is ~~an~~ enough of a margin to the eye mask prescription near an upper left part of a central portion of the eye pattern (a rising part indicated by W1 in Fig. 20). However, the eye mask margin is quite small near an upper right part of the central portion (a rising part indicated by W2 in Fig. 20), with the result that there is no margin at all to the eye mask prescription. Therefore, a problem occurs that if, for example, a surrounding temperature rises, a relaxation oscillation frequency of the optical semiconductor falls and the signal waveform cannot satisfy the upper right part of the central portion of the eye mask.

Please replace the paragraph beginning at line 3 on page 5 with the following rewritten paragraph.

In a high frequency region such as a region at the frequency near 10 gigahertz, both ends of inductance ~~elements~~ element 311 shown in the example of Fig. 44-18 are fixed to a ceramic substrate, and a plurality of pad sections each including a conductor are provided to arrange wirings by wire bonds. Since each pad

section functions as a capacitance, a resonance is generated by these capacitances, a plurality of wires by the wire bonding that connect the LD 310 to pads provided between the inductance element 311 and the matching resistor 309, and a reactance component of the inductance element 311 that constitutes the bias circuit. This results in quite sharp damping characteristics.

Please replace the heading in line 7 on page 6 with the following rewritten heading.

~~DISCLOSURE~~ SUMMARY OF THE INVENTION

Please replace the heading in line 1 on page 17 with the following rewritten heading.

~~BEST MODE FOR CARRYING OUT~~ DETAILED DESCRIPTION OF THE INVENTION

Please replace the paragraph beginning at line 7 on page 17 with the following rewritten paragraph.

Fig. 1 is a circuit block diagram which illustrates one example of an optical semiconductor device according to the first embodiment. In Fig. 1, an LD driving circuit 1 includes an input buffer 11 which has a differential input configuration, a pair of differential transistors 12 and 13 which have a differential configuration and which output an antiphase signal and a positive phase signal, respectively, a transistor 14 which performs a constant-current operation, and resistors 15 and 16 which are loads of collectors of the differential transistors 12 and 13, respectively, and which ~~make perform~~ impedance matching.

Please replace the paragraph beginning at line 2 on page 22 with the following rewritten paragraph.

Accordingly, the modulated electrical signals output from the differential transistors 12 and 13 constituted to be differential from each other in the LD driving circuit 1 are transmitted to the LD 20 through the distributed constant circuit 18 and the like, and are converted to an optical modulation signal in the LD 20. The

modulated optical signals generated from the LD 20 are condensed on an optical fiber 26 by a condenser lens 25 and the condensed, modulated optical signal is output through this optical fiber 26.

Please replace the paragraph beginning at line 13 on page 15 with the following rewritten paragraph.

The circuits in the optical semiconductor device according to the present invention shown in Fig. 1 perform such ~~an~~ a push-pull operation. Therefore, the distributed constant circuit 18 serves as differential lines, and performs current push and pull for the LD 20 simultaneously. If the operation is viewed from the LD 20, the circuits operate for an average time $((t_r + t_f) / 2)$ between the rise time (t_r) of the differential transistor 12 and the fall time (t_f) of the differential transistor 13. As a result, as shown in Fig. 2B, the paired transistors 12 and 13 exhibit symmetric rise characteristics in that the rise time and the fall time are averaged.

Please replace the paragraph beginning at line 5 on page 24 with the following rewritten paragraph.

Near an upper right part (a rising part indicated by F in Fig. 3) of a central portion of the eye pattern, in particular, there is ~~an~~ enough of a margin to the eye mask prescription, so that there exists a margin to a waveform deterioration following a lowering in the relaxation oscillation frequency of the LD 20 due to an increase of a using temperature.

Please replace the paragraph beginning at line 10 on page 24 with the following rewritten paragraph.

Further, in order to improve the rise characteristics of the LD driving circuit having the relatively long rise time and fall time shown in Fig. 19, the LD driving circuit 200 is adjusted to have peaking characteristics. If so, a slight ringing at a frequency around 15 gigahertz higher than a signal band often occurs and is superposed on the electric waveform shown in Fig. 19.

Please replace the paragraph beginning at line 5 on page 25 with the following rewritten paragraph.

Japanese Patent Application Laid-Open Publication No. 5-327617 discloses that only the fall time is improved by reducing the input impedance of the LD₁ which impedance is viewed from the driving circuit. Therefore, the invention of the publication ~~entirely~~ differs entirely in principle from the present invention.

Please replace the paragraph beginning at line 11 on page 29 with the following rewritten paragraph.

Fig. 5 is a circuit block diagram which illustrates one example of the optical semiconductor device in the second embodiment. In FIG. 5, the LD driving circuit 1 includes the input buffer 11 which has a differential input configuration, the paired differential transistors 12 and 13 which have a differential configuration to output an antiphase signal and a positive phase signal, respectively, the transistor 14 which performs a constant-current operation, and the resistors 15 and 16 which are resistors against the loads of collectors of the differential transistors 12 and 13, respectively, and which ~~make perform~~ perform impedance matching.

Please replace the paragraph beginning at line 16 on page 33 with the following rewritten paragraph.

Japanese Patent Application Laid-Open Publication No. 7-38185 discloses, in ~~Figs. 6A and 6B~~ Figure 6 thereof, a circuit in which serial circuits including a capacitance and a resistor are inserted in parallel to an LD element and which thereby prevents the ringing of rise characteristics. An object of this circuit is, however, to remove an overshoot which occurs because no bias current is applied and a relaxation oscillation, which object differs from the object of the present invention. Further, the circuit of the publication differs from the present invention in that the circuit is a single-phase feed type and also differs in circuit configuration.

Please replace the paragraph beginning at line 25 on page 33 with the following rewritten paragraph.

Japanese Patent Application Laid-Open Publication No. 7-46194 discloses, in Fig. 1 and ~~Figs. 2A and 2B~~ Fig. 2 thereof, a circuit which changes a matching state by connecting, in parallel, serial circuits including an inductance and a resistor to an LD element between a matching resistor and an LD driving circuit, to thereby prevent a ringing. However, ~~the invention~~ this circuit differs from the present invention in object and circuit configuration and also differs in that the circuit is of a single-phase feed type.

Please replace the paragraph beginning at line 20 on page 34 with the following rewritten paragraph.

For example, if the impedance Z of the LD driving circuit side is 100 ohms, the internal resistance r of the LD 20 is 8 ohms, ~~and the resistances R_d of the matching resistors are 45 ohms,~~ and the capacitance C of the filter 27 is 0.16 picofarad, then the cutoff frequency f_c is approximated to about 10 gigahertz. Since the actual circuit constant is complicated, the cutoff frequency cannot be simply obtained. However, if the capacitance is set based on this cutoff frequency f_c , a desired filter effect can be obtained.

Please replace the paragraph beginning at line 16 on page 36 with the following rewritten paragraph.

Fig. 9A is a simplified equivalent circuit diagram which simulates a high frequency operation of the conventional optical semiconductor device shown in Fig. 18. In Fig. 9A, reference symbol 31 denotes the output impedance of the LD driving circuit, 309 denotes a matching resistor, and 310 denotes the internal resistance of the LD. Reference symbol 329 is the wire bond that connects pads_{[[,]]} (not shown in Fig. 9A)_{[[,]]} provided on the conductor line electrically connected to the matching resistor 309 and to the cathode of the LD 310. Reference symbol 32 denotes the bias circuit including the inductance element 311 such as the solenoid. Although the resistances should actually be reactances, the resistances are shown for simplifying explanation of fundamental passing characteristics in Figs. 9A, 9B, 10A, and 10B.

Please replace the paragraph beginning at line 9 on page 43 with the following rewritten paragraph.

Fig. 14 illustrates the outside configuration of the optical semiconductor element module (hereinafter, "LD module" since an example of mounting the LD will be mainly explained in this fifth embodiment) 103 which includes a can package 101 and a receptacle 102. ~~Fig. 15(a) and Fig. 15(b)~~ Figs. 15A and 15B are a horizontal sectional view (a view of a surface parallel to x shown in Fig. 14) and a vertical sectional view (a view of a surface parallel to y shown in Fig. 14) of the LD module 103, respectively.

Please replace the paragraph beginning at line 25 on page 43 with the following rewritten paragraph.

As shown in Figs. 15A and 15B, the cap 113 has a double cylinder form which includes a first cap member 113a fixed to the stem 110 by projection welding or the like and a second cap member 113b fitted into a tip end side of the first cap member 113a from outward and fixed to the first cap member 113a by YAG welding or the like. Specifically, the first cap member 113a includes stepped outer cylinders, and the outer cylinder having a smaller diameter is provided on the tip end of the outer cylinder having a larger diameter. An inner cylinder of the one end-side second cap member 113b is fitted into the outer periphery of the outer cylinder having the smaller diameter, and the first cap member 113a is fixed to the second cap member 113b by ~~through~~-YAG welding.

Please replace the paragraph beginning at line 2 on page 45 with the following rewritten paragraph.

The receptacle 102 includes a ferrule insertion hole 119 for inserting a ferrule 121 (see Fig. 14) to which an optical fiber 120 is connected, and holds the optical fiber 120. The dummy ferrule 118, in which an optical fiber 118a is arranged, is press-fitted and fixed into a can package 101-side in the ferrule insertion hole 119. One end face of the receptacle 102 on the side, on which the dummy ferrule 118 is fixed, is fixed to an end face on the other end side of the second cap member 113b ~~is fixed to an end face of the other end side of the second cap member 113b in the~~

can package 101 by butt welding using YAG welding or the like. By making a positioning adjustment relative to two directions vertical to the laser light axis direction when fixing the receptacle 102 to the second cap member 113b, the condenser lens 25 is aligned to the dummy ferrule 118 in the receptacle 102 relative to the two directions at right angles with respect to the laser light axis.

Please replace the paragraph beginning at line 15 on page 47 with the following rewritten paragraph.

The micro-strip differential line substrate 146 includes a ceramic substrate 151, a pair of strip differential signal lines 152a and 152b formed on an upper surface of the ceramic substrate 151, and the ground conductor layer (not shown) formed on the rear surface of the ceramic substrate 151. Pads 153a and 153b to contact with the high frequency signal pins 141a and 141b protruding from the stem 110 are formed on one-end sides of the strip differential signal lines 152a and 152b, respectively. Capacitive stubs 154a and 154a for impedance matching which protrude to be closer to each other signal line are formed halfway along the strip differential signal lines 152a and 152b, respectively. The strip differential signal lines 152a and 152b are set to have a larger distance therebetween in input-side portions near the stem 110 so as to correct an impedance of the field-through section the whose impedance of which tends to be low. The strip differential signal lines 152a and 152b each include a portion in which the distance between the signal lines is gradually smaller and an output-side portion in which the distance between the signal lines is close and in which the signal lines are arranged in parallel. End portions of the high frequency signal pins 141a and 141b mounted on the stem 110 are connected and fixed to the pads 153a and 153b of the micro-strip differential line substrate 146 by brazing or soldering.

Please replace the paragraph beginning at line 15 on page 51 with the following rewritten paragraph.

A pair of pin insertion holes 180a and 180b are formed in the dielectric 177, and the high frequency signal ~~pines-pins~~ 141a and 141b are inserted into and fixed to the pin insertion holes 180a and 180b, respectively. Likewise, holes (reference

symbols of which are not shown) are formed in the dielectrics 178, 179a, and 179b, and the monitor signal pin 143 and the bias feed pins 144a and 144b are inserted into and fixed to the holes, respectively. The dielectric 177 into which the paired high frequency signal ~~pines~~pins 141a and 141b are inserted has an oval form in this example. Accordingly, the hole 174 into which the dielectric 177 is inserted has an oval form. The other dielectric 178, 179a, and 179b are circular. It is noted that the ground pins 142a and 142b are fixedly attached to an outer wall surface[[,]] (not shown)[[,]] of the stem 110 by press-fitting and welding.